Notes

C7000 & C7000ER Battery Analyzer User's Manual

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All functions and performance of the Cadex C7000 and C7000ER Battery Analyzers are independent of the date stored in the analyzer. Therefore, all functions and the performance of the C7000 and C7000ER Battery Analyzers are not affected by dates during and after the year 2000.

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89-207-1001 Rev 8 March, 2000 Printed in Canada

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1 Overview

The Cadex C7000 and C7000ER Battery Analyzers are sophisticated programmable battery analyzers capable of servicing batteries with different electrical properties and mechanical dimensions.

Product Features

- Service Nickel Cadmium (NiCd), Nickel-Metal Hydride (NiMH), Sealed Lead Acid (SLA) and Lithium Ion (Li-Ion). The C7000 and C7000ER are also capable of supporting Smart Batteries based on the ‘single wire’ and SMBus system.
- Operate each station simultaneously and independently of each other.
- Support over 600 interchangeable Battery Adapters for easy interface with most commercially available battery models.
- The Battery Adapter contains the battery configuration code, also known as *C-Code*, which automatically sets the analyzer to the correct parameters for serving the battery. Each adapter contains 10 C-Codes to accommodate different batteries in the same product family.
- Offer a variety of programs for battery services: 3 Basic Programs (**Auto**, **Charge**, **Prime**), 6 Specialty Programs and 4 user-programmable Custom Programs.
- Easy to use menu-driven interface, plain English messages and status lights.
- Support fleet management. Support bar code entry, print Bar Code Labels and Battery Labels, and produce a range of reports.
- Can be networked for automated battery maintenance with BatteryShop™.

What's New in the C7000 V3.5 firmware

At Cadex, it is our goal to continue to listen to feedback and suggestions from customers, and improve our products. Below is a list of product enhancements:

Version	New Features/Changes
3.5	Runtime program Support for BatteryShop 3.0 Definable Resistance Threshold in OhmTest Recognition of 16Kb Battery Adapters Improved NiMH charge algorithm Reorganized programs, separated Basic and Specialty Programs 4 additional Custom Programs Improved user interface
3.4	Support for BatteryShop General updates
3.3	Improved OhmTest Incorporation of OhmTest into the Auto, Prime and Charge programs Automatic identification of battery parameters through Battery Adapters
3.2	OhmTest to test battery internal resistance in 5 seconds Support for label printer Temperature sensor to improve safety Display of battery model numbers Improved NiMH charge algorithm Improved bar code

Warranty & Services

Cadex Electronics Inc. warrants the Cadex C7000 and C7000ER Battery Analyzers against defective materials and workmanship for a period of two (2) years from the original purchase date.

The warranty does *not* cover

- Any damage due to abusive operation, negligence, accident or improper installation.
- Any damage caused by an attempted repair not authorized by Cadex.
- Cosmetic damage caused by normal wear and tear.
- External causes of damage such as leakage spills, power fluctuations or failure, or shipping.
- Product received without the appropriate model number, serial number or safety markings.
- Product used for rental purposes.

Obtaining Warranty Service

1. Contact Cadex Technical Support. If the service representative has determined that your product needs to be returned for service or replacement, the representative will fax or provide a Return Authorization number with the location of the nearest service center.
2. Ship the product to the service center with freight, insurance and customs duties prepaid. Include the Return Authorization number provided by Cadex or the service center. *All products must be returned with a Return Authorization number supplied by Cadex or a Cadex service center.*

Products returned from warranty service will be sent with freight prepaid by Cadex.

Non-warranty Repairs

Cadex will provide an estimate and will proceed with the repairs only after you have provided a written authorization or a Purchase Order number. You will also need a Return Authorization number.

Shock Hazard

The C7000/C7000ER Battery Analyzer contains high-voltage circuits, and can pose a shock hazard when the upper cover is removed. *Do not attempt to perform any service procedures on the analyzer other than replacement of the fuses or internal backup battery.*

- ✔ Use the analyzer only as specified in the documentation. Other uses may impair the protection provided by the unit.
- ✔ Use only a grounded AC outlet to power the analyzer.
- ✔ Before attempting any internal service, remove all batteries from the battery stations, turn the analyzer off, and disconnect the power cord from the wall socket. Wait a few minutes (30 minutes for the C7000ER) before opening the cover.
- ✔ Replace fuses only with fuses of the same type and rating.
- ✔ Replace the internal backup battery only with the same type. Observe the correct polarity when installing the backup battery. Discard the used battery according to the battery manufacturer's instructions.

Firmware Upgrade: Resetting the System

If you are upgrading the analyzer firmware to V3.5 from an older version, you need to reset the system to the factory defaults to erase the old system parameters.

Some of the parameters that are reset include:

- **OhmTest**, **Runtime**, **Self-Discharge**, **Life-Cycling** and Custom Programs
- Battery Startup settings
- Parallel Port Device to **Printer**
- Serial Port Device to **LabelMaker**
- Voltage Display to **Volts/Cell**
- Number of batteries serviced (Service Counter) to **0**

▸ Press and release the **Alt** key, then press **0**.

Note that this function also serves as a general system reboot.

Connecting to BatteryShop™

BatteryShop™ is a powerful Windows-based battery management tool that allows automation of the C7000 and C7000ER functions to increase productivity.

- Provides control and monitoring of large scale battery services by connecting up to 120 analyzers to service 480 batteries simultaneously.
- Contains a database of over 2000 battery models that provides easy access to C-Code settings and other information. Even a novice user can perform a variety of tests and programs.

Refer to ***Serial and Parallel Device Settings*** or BatteryShop Help on preparing the analyzer for BatteryShop.

To find out how BatteryShop can enhance your battery maintenance system, contact Cadex.

Peripherals

The C7000 and C7000ER support the following peripherals to maximize performance:

- Epson compatible dot-matrix printer to print reports.
- Label Printer to print labels. The DYMO LabelWriter SE300 is recommended. For more information on label printers, contact Cadex or DYMO-CoStar.
- Bar Code Scanner to scan bar-coded labels. The bar code scanner is included with the purchase of the OP-72 option board.

Explosion Hazard

Batteries can burst if treated improperly. Follow these precautions at all times.

- ✔ Clean battery contacts before servicing. Press the battery firmly into the adapter to ensure a good connection.
- ✔ Ensure that the selected C-Code is correct for the chemistry, voltage, and current rating of the battery being serviced.
- ✔ Observe battery temperature. Stop service if battery becomes very hot. Service batteries between 0°C (32°F) and 60°C (140°F). Fast-charging outside this temperature range may cause damage to the battery. Allow cold batteries to warm up and hot batteries to cool before charging.
- ✔ Use only a grounded AC outlet to power the analyzer.

- ✕ Do not attempt to charge non-rechargeable batteries such as alkaline, carbon-zinc, or non-rechargeable lithium.
- ✕ Do not short the positive and negative battery terminals together at any time.
- ✕ Do not connect leads from one station to another or to the case. An electrical short to any point outside the station bypasses the current regulation loop and may cause a fuse to blow and/or damage to the unit.
- ✕ Do not exceed the manufacturer’s recommended charge current and voltage limits for batteries.
- ✕ Do not restrict the airflow of the analyzer. Leave the fan opening clear. Fan operation is automatic.

Radio Interference

This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class “A” digital device pursuant to Subpart B of Part 15 of the FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference in which case the user, at his own expense will be required to take whatever measures required to correct the interference.

EN55022 Warning: This is a Class A product according to EN55022. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate corrective measures.

The equipment is designed with adequate safeguards to protect the user from shock and other hazards when used as specified within this documentation. If the equipment is used in a manner not specified by the documentation, the protection provided by the equipment may be impaired. Please read the documentation and equipment labeling before using the equipment.

Contents of Box

The Cadex C7000/C7000ER Battery Analyzer package includes:

- 1 C7000/C7000ER Battery Analyzer
- 1 IEC320 Power Cord (C7000-1 only)
- 1 User’s Manual

About this Manual

The **C7000 &C7000ER Battery Analyzer User’s Manual** contains the concept, procedures, and information that is necessary to operate the analyzer.

Conventions

Typeface	Meaning
Italic	Words that are emphasized
Bold	Keys to press Options to select on the menu Service Programs
Bold & Italic	Name of sections in this manual Warnings
Bold-Bold	Press and release the first key then the remaining key(s)

Symbols

Symbol	Meaning
	Information that, if ignored, can result in damage to the C7000/C7000ER Battery Analyzer, Battery Adapters or the battery.
	Shock Hazard.
	Explosion Hazard.

Abbreviations and Acronyms

Abbreviation	Name or Term
AWG	American Wire Gauge. A U.S. wire size standard.
BMS	Battery Maintenance System.
LCD	Liquid Crystal Display. Referred to as *Display*.
LED	Light Emitting Diode. Referred to as *Light*.
Li-Ion	Lithium-Ion battery chemistry.
NiCd	Nickel Cadmium battery chemistry.
NiMH	Nickel-Metal Hydride battery chemistry.
OEM	Original Equipment Manufacturer.
RF	Radio Frequency.
P/N	Part Number.
SLA	Sealed Lead Acid battery chemistry.

You can reach Cadex Technical Support by phone at 8:00 am - 4:30pm Pacific Time (GMT -08:00), Monday through Friday.

- Technical Support Phone: +1 604 231-7777
- Toll Free: + 1 800 565-5228 (US and Canada only)
- Fax: +1 604 231-7755
- Email: service@cadex.com
- Mail: Cadex Electronics Inc.
  22000 Fraserwood Way
  Richmond, BC
  Canada V6W 1J6
  Attn: Product Support

Manual Updates and Other References

We maintain an Internet Web site as an additional resource and reference for those who work with batteries. Detailed technical and practical information about all aspects of battery maintenance is available at **www.cadex.com**:

- Articles and Technical Papers
- Frequently Asked Questions about Batteries
- Battery Adapter Catalog
- Updates of User's Manuals

Technical Support

If you have a technical problem that cannot be solved with this manual or the Cadex Web site, you can contact our Technical Support department by phone, fax, email, or mail. Please provide the following information:

- Serial Number of the analyzer.
- Firmware Version. You can find the version number by pressing **Fn**-**7**.
- Display message and/or code.
- LED lights that are on or flashing.
- What happened and what you were doing when the problem occurred.

For questions related to batteries or adapters:

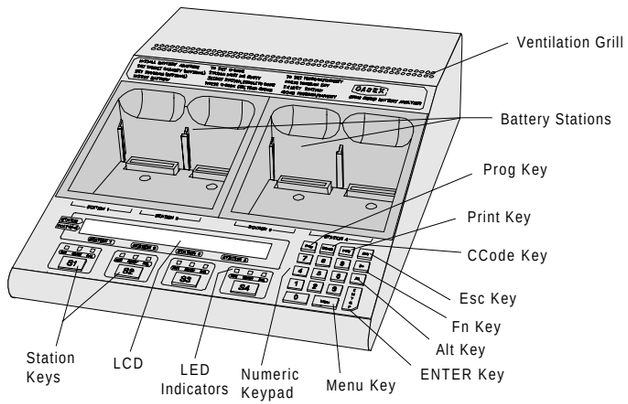
- Battery Model Number.
- Adapter Number.
- C-Code being used.
- Display message and/or code.

Commonly Used Terms

Term	Explanation
Ampere Hour (Ah)	Battery capacity or rating. A battery that provides a current of 1 ampere for 1 hour is rated at 1Ah.
Configuration Code (C-Code)	Battery parameters stored in Battery Adapters to service a battery. Refer to ***Battery Configuration/C-Codes.***
C-Rate	Unit by which charge and discharge times are scaled. For example, a battery rated at 1000mAh provides 1000mA for 1 hour if discharged at 1C. A discharge of 1C draws a current equal to the rated capacity. The same battery discharged at 0.5C would provide 500mA for two hours.
Intrinsically Safe (I/S)	Battery with built-in safety protection circuitry. These batteries are primarily used in explosive environments.
Recondition	A deep discharge below 1.0V/Cell with a controlled current. Recondition helps to revert large crystals as a result of memory to small desirable sizes, often restoring the battery to its full capacity. Applies to NiCd and NiMH only.
Residual Capacity	Charge capacity remaining in the battery when inserted in an analyzer.
Smart Battery	Battery equipped with specialized circuitry that can communicate with an analyzer and provide battery information.
Target Capacity	The battery capacity benchmark for pass/fail set by the user.

Operating Principles

Components



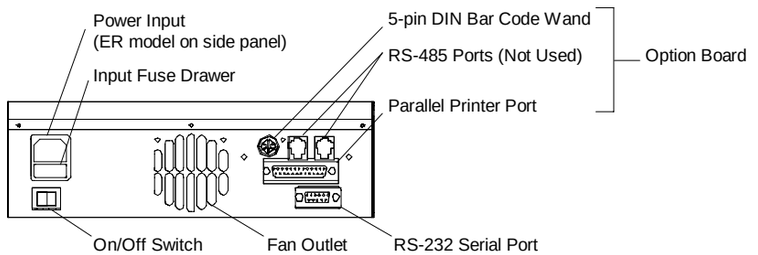
Component	Function
Battery Stations	Take Battery Adapter.
Prog Key	Access service programs and Target Capacity.
Print Key	Print labels and reports.
CCode Key	Access battery parameters.
Esc Key	Exit menus or cancel changes.
Fn Key	Shortcuts to common functions when pressed with a second key.
Alt Key	Reset to factory defaults when pressed with the **0** key after a firmware upgrade or as a general system reboot.
ENTER Key	Save settings and start servicing.
Menu Key	Access menu.
Numeric Keypad	Enter numeric parameter settings.
LED Indicators	Provide current status of batteries in service. Activated when a service starts.
LCD	View status for each station and detailed service information.
Station Keys	View C-Codes, details of a service, or as cursor keys in editing mode.

	Problem	Possible Reason(s) / Solution(s)
9.	Program did not resume after a power failure.	Check if an option board (OP-70 or OP-72) is installed. The option board sticker is at the back of the analyzer. The option board configuration is also displayed during start-up.
		The analyzer was saving the battery information when the power failed. Battery information is saved once a minute. If the power fails during the information save, the program will not continue when power resumes.
		Replace the backup battery.
10.	Single cell gives inconsistent results.	Calibrate the station.
		Set the charge method in the Extended C-Code to **DC Charge** due to low terminal voltage.
		Single cells are discharging and/or charging too quickly. Lower the Discharge rate and Charge rate to about 0.2C.
11.	Capacity readings between stations are inconsistent.	Verify that the C-Codes are the same between stations.
		Calibrate the stations.
12.	Resistance readings are consistently high.	Calibrate the station.
		The battery or adapter contacts may be damaged.
		The battery is faulty.
13.	Battery passes on analyzer but fails in the field.	Use the **OhmTest**. If the resistance is high, the battery may not be able to hold charge.
		Use the **Self Discharge** program to check the difference of the last two readings. If it is more than 30%, the battery fails.

	Problem	Possible Reason(s) / Solution(s)
6.	Printing Problems.	Check the serial port setup of the serial printer. Check that the serial or parallel port is enabled for correct print device. Set the other port to **Disabled**. The **LabelMaker** option in the **Serial Port Device** or **Parallel Port Device** of System Setup is wrongly selected. Select **Printer** instead. Check if the serial cable is correctly configured (refer to ***Serial Port Settings*** for serial cable pin configurations).
7.	Battery service does not start.	Ensure that the adapter is firmly inserted into the analyzer. Check that the battery is correctly and firmly inserted into the adapter. Make sure that the contacts on the battery are meeting the contacts on the adapter. Turn on the battery switch if applicable. Press **ENTER** after selecting the C-Code and the service program. Check that the selected C-Code is correct for the battery.
8.	Connection between battery and the analyzer is intermittent.	The battery may be intrinsically safe. Change the charge method in the Extended C-Code to **DC Charge**; lower the Charge rate and Discharge rate; reduce the End of Discharge to 0.92V/Cell.

Option Boards

All models of the C7000 and the C7000ER come with a RS-232 Serial Port that connects to a label printer or to BatteryShop. There are 2 option boards, OP-70 and OP-72, that can be purchased for additional support. (The C7000ER is already equipped with the OP-70 option board.) The option board sticker is at the back of the analyzer. The option board configuration is also displayed during start-up.



Note that the option board is blank unless purchased.

Components

- **Parallel Printer Port:** connects to a parallel printer. Refer to ***System Setup*** on how to set up the parallel port device settings.
- **Battery Backup RAM:** retains test data on power interruption, resumes service when power is restored, and retains dates and time.
- **Bar Code Wand:** reads bar-coded labels.

	OP-70	OP-72
Parallel Port	✔	✔
Battery Backup RAM	✔	✔
Bar Code Wand	Not Activated	✔

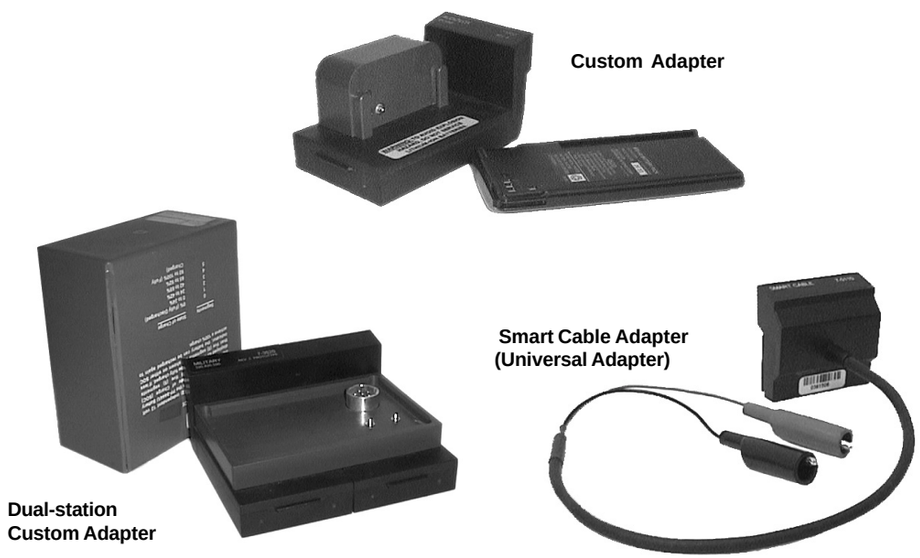
You can upgrade your standard analyzer to OP-70 or OP-72. Contact Cadex for upgrade information.

Battery Adapters

Adapters are designed to fit specific battery types and shapes. The snap lock latch allows easy insertion and removal.

There are 3 types of Battery Adapters:

Adapter Type	Description
Custom Adapters	Accommodate any specific battery shape. There are over 600 Custom Adapters available.
Dual-station Custom Adapters	Designed to handle dual packs that contain 2 separate battery systems.
Smart Cable Adapters (Universal Adapters)	Used when a Custom Adapter for a battery is not available. Alligator clips attach to positive and negative terminals.



Troubleshooting

The common problems and solutions listed below will answer most of your questions. The detailed alphabetical list of display messages in ***Messages and Warnings*** can help to sort out problems not listed here.

If personalized help becomes necessary, contact Cadex Technical Support.

	Problem	Possible Reason(s) / Solution(s)
1.	The C7000 does not power up.	Check that the power input on the rear label is correct. Make sure that the power cord is firmly inserted in the back connector. Check the input fuses.
2.	The fan turns off and on, even when no battery is being analyzed.	This is normal.
3.	Password is not accepted even though no password is stored in the analyzer.	Replace the backup battery.
4.	Dates are changing or negative dates are appearing.	Replace the backup battery.
5.	Bar Code Wand reads intermittently.	Use correct bar-code format: C-Code - ’2 of 5’; ID - ’3 of 9’ or bar 128 format. The label is damaged or dirty. A fast swipe reads better than a slow swipe. Try a different angle and speed. Artificial lights, fluorescent lights and direct sunlight can affect the wand.

Firmware

Firmware Version	**Version 3.5**			
Supported Chemistries	**NiCd**	**NiMH**	**SLA**	**Li-Ion**
Supported Settings	All Types	All Types	Gell, Hawker	All Types
Voltage				
C7000-1, 2 & 9	1.2V-14.4V	1.2V-14.4V	2.0V-16.0V	3.6V-14.4V
C7000-ER	1.2V-28.8V	1.2V-28.8V	2.0V-30.0V	3.6V-28.8V
Battery Rating/ Capacity	100mAh-24,975mAh	100mAh-24,975mAh	100mAh-24,975mAh	100mAh-24,975mAh
Charge Method	Reverse Load		Constant voltage with current limit	
Display Format				
Capacity	Percentage of nominal rating			
Voltage	Volts/Cell or Volts			
Temperature	ºC			
Resistance	mΩ			
Auto Service Frequency (Standby)	30 Days	30 Days	180 Days	30 Days
Security	3 Level Password Enabled Security (Off, Low, High)			
Outputs	Battery Labels, Bar Code Labels, Battery Service Reports, System Setup Reports			
Printer Support	Epson compatible dot-matrix (9-pin), DYMO LabelMaker SE300 Printer			

Each adapter contains up to 10 battery parameters (C-Codes) for optimal battery services. Once the adapter is inserted, the battery station receiving the adapter automatically chooses the last selected C-Code as the active C-Code.

Note that Smart Cable Adapters need to be programmed, and the user must enter the correct C-Code settings for the battery to be serviced. Refer to ***C-Codes*** for more information.

For Li-Ion batteries of greater than 7.2V (2 cells), a custom designed adapter is strongly recommended.

Cadex continuously designs adapters for new battery models and also designs custom adapters for a nominal fee. Please contact Cadex for a current adapter catalog or download a copy from our Web site, www.cadex.com.

Special Handling Tip for Smart Cable Adapters

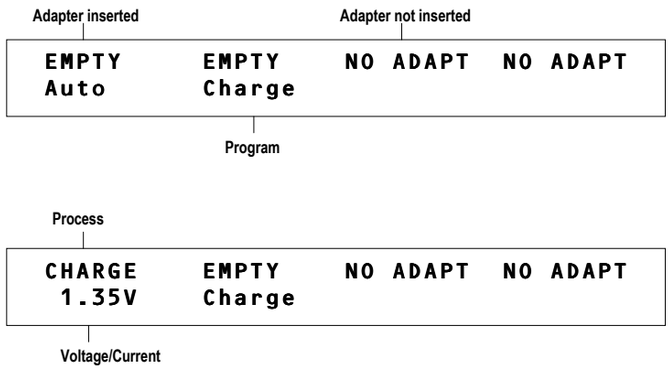
- Insert a battery only when the Smart Cable Adapter is inserted into the station. Likewise, do not remove the adapter before the battery is removed.

Specifications

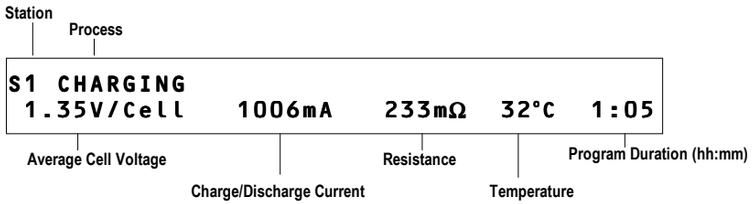
User Interface

Display

- **Global Display:** provides status information of stations and batteries in service at a glance.



- **Detailed Display:** provides detailed information about the battery service or station *when the appropriate station key is pressed*. For example, during a service in Station 1, the following is displayed when the **S1** key is pressed:



Pressing the station key again will give additional details such as warning codes, cycles and program phases.

Hardware

	C7000-1 Standard	C7000-2 Standard	C7000-9 Standard	C7000-ER Extended Range
Part Number	07-771-0000	07-772-0000	07-779-0000	07-778-0000
Line Voltage	115VAC ±10%	100VAC ±10%	220-240VAC ±5%	90-250VAC
Frequency	60Hz	50-60Hz	50-60Hz	47-63Hz
Main (Input) Load	max 180W	max 180W	max 180W	225W (Power Factor Corrected)
Output Load				
Total*	max 80W	max 80W	max 80W	max 160W
Current/Station	max 2A	max 2A	max 2A	max 2A
Operating Temp.	0°C to 40°C (32°F to 104°F)			
Dimensions				
Width	280mm (11.0")	280mm (11.0")	280mm (11.0")	280mm (11.0")
Depth	374mm (14.7")	374mm (14.7")	374mm (14.7")	412mm (16.7")
Height	88mm (3.6")	88mm (3.6")	88mm (3.6")	95mm (3.75")
Weight	6.3kg (13.9lb); with option board: 6.4kg (14.1lb)			5.7kg (12.6lb)
Accuracy				
Voltage	±1% at max rated voltage			
Current	±2.5% at 1A			
Throughput	4 batteries every 4 - 8 hours (up to 160 batteries per month) based on 2 batches per day.			
Connectors	3-pin AC plug IEC320 Power Cord (only available on C7000-1) Serial DB-9 RS-232 (standard on all models) Parallel DB-25 (OP70 and OP-72 only) DIN Jack (5-pin) for Bar Code Wand (OP-72 only)			
Interface				
LCD	80 Character with multiple display formats (Global, Detailed, Menu)			
LED	3 Status lights (RUN, READY, FAIL) for each station			
Keypad	Numeric pad with 8 function keys, 4 station selection/cursor keys			
Warranty	Limited (2) years parts and labor			
Approvals	Tested and approved by ITS to comply with CSA/UL/CE standards			
Options	Battery Backup RAM (OP-70 and OP-72) Bar Code Reader (OP-72) Windows-based BatteryShop™			

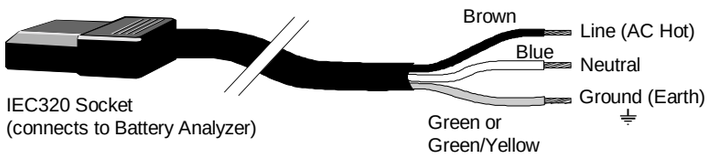
* Continuous, intelligent overload protection.

5. Install a new backup battery and make sure that the battery is inserted properly. If the ribbon cable was removed, replace the cable.
6. Replace the upper cover (make sure the front edge of the top cover is properly inserted into the notches in the plastic cups for the C7000), and re-install the screws to secure the cover.

IEC320 Power Cord

The C7000 and C7000ER use a standard IEC320 power connector, allowing you to obtain suitable power cords for connection to any standard line voltage source. If you need a special power cord for your particular wall socket, obtain an approved cord fitted with an IEC320 socket at one end, and the appropriate local fitting at the other end.

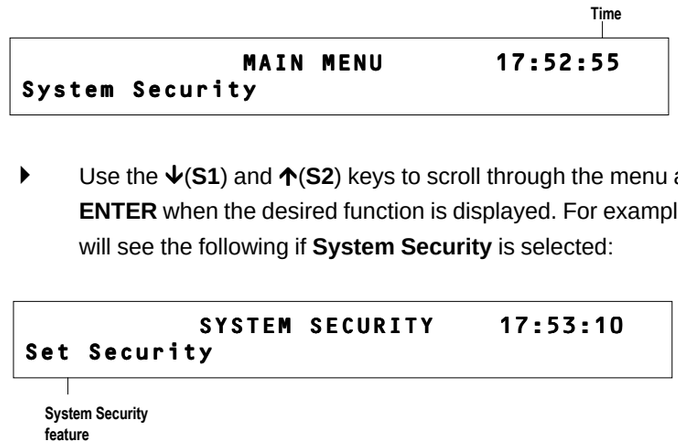
If you obtain a universal IEC320 power cord with a socket but no plug, the appropriate plug should be connected as follows:



- Brown = Line (AC Hot)
- Blue = Neutral (AC Neutral)
- Green or Green/Yellow = Ground (Earth)

Warning: Make sure this is conducted by a licensed electrician.

- **Menu Display:** provides access to various functions of the analyzer when the **Menu** key is pressed.

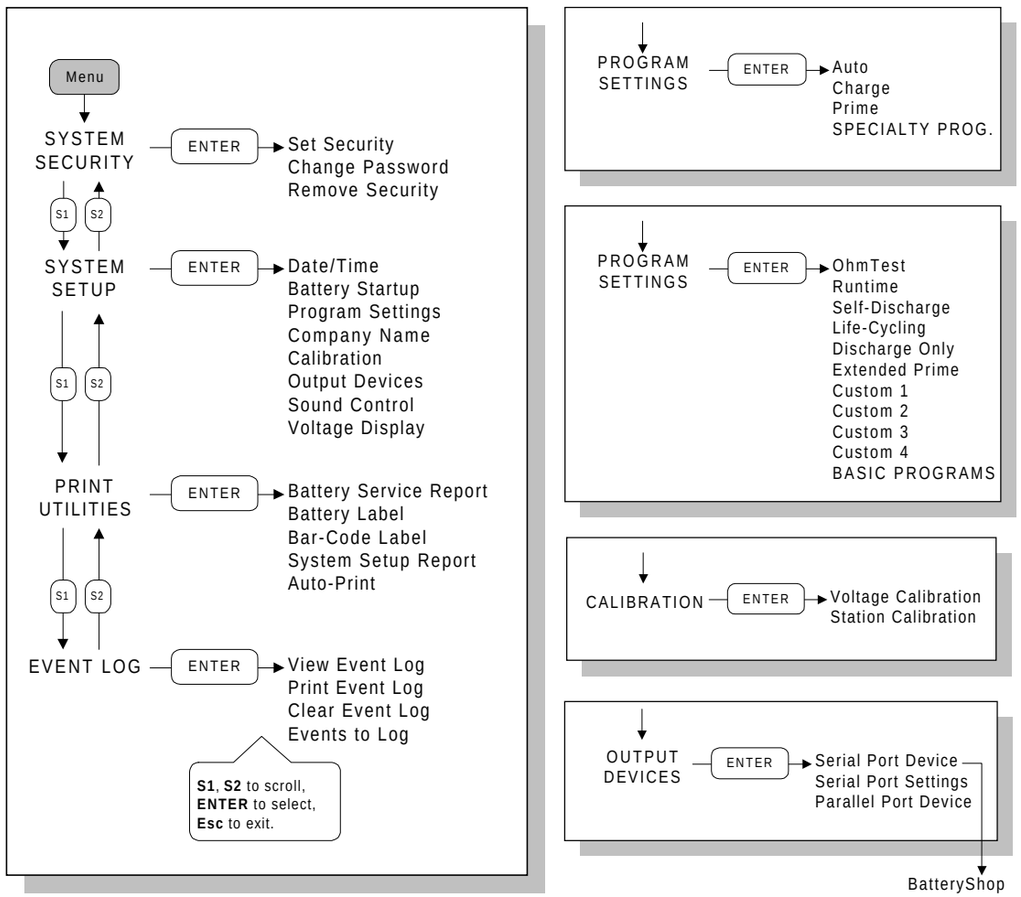


▸ Use the ↓(**S1**) and ↑(**S2**) keys to scroll through the menu and press **ENTER** when the desired function is displayed. For example, you will see the following if **System Security** is selected:

See ***Menu*** for the overview of the functions.

Menu

The menu-driven interface allows access to the various functions of the analyzer. Refer to the individual functions for details and instructions.



Replacing Backup Battery (with OP-70 or OP-72 only)

An analyzer equipped with the OP-70 or OP-72 option board contains a backup battery to retain date/time, print formats and other information when the power is off or interrupted. With the analyzer off, the battery lasts for 2 to 3 years; with the analyzer on, the backup battery can last for 10 years.

Replace the battery if the date/time setting is no longer retained after the analyzer is turned off.

Model	Backup Battery	Size	Replacement	Cadex P/N
All	3V, 200mAh	200 x 3.2mm	Panasonic BR2032 or Standard CR2032	45-206-0001

Warning: Make sure the polarity is correct when replacing the backup battery. Discard the used battery according to the battery manufacturer's instructions. Failure to do so may cause explosion.

1. Remove all batteries and adapters, turn the analyzer off and unplug power cord.
2. Unscrew the 3 screws located on the rear of the C7000 (2 screws on the C7000ER) to remove the top cover.
   - The cover will still be attached to the C7000 by a grounding strap. Put the cover to one side.
3. Locate the backup battery on the option board mounted vertically in the rear corner of the analyzer.
4. Gently lift the retainer arm which holds the backup battery and slide the battery out. Take care *not to short-circuit the backup battery or touch any of the other electronic components* inside the analyzer. Do *not* use a metal screwdriver or something similar. The ribbon cable or the option board may have to be removed in order to access the backup battery.

4. If necessary, check the removed fuse with an ohmmeter to confirm diagnosis and/or replace the station fuse.
5. Replace the upper cover of the C7000, (make sure the front edge of the top cover is properly inserted into the notches in the plastic cups), and re-install the screws to secure cover.

Extended Range Model (C7000ER)

1. Remove all batteries and adapters, turn off the analyzer and unplug power cord. *Wait 30 minutes to allow the voltage to discharge.*
2. Unscrew the 2 screws located on the rear to remove the top cover. Disconnect the wire on the power supply circuit board that is attached to the power assembly filter.
3. Remove the open fuse from the holder, taking care *not to touch any of the electrical components*. The station fuses are located in the left rear corner of the analyzer on the motherboard (refer to the diagram for standard model).
4. If necessary, check the removed fuse with an ohmmeter to confirm diagnosis and/or replace the station fuse.
5. Reconnect the wire on the power supply board and re-install the screws to secure cover.

Commands

To	Press
Select a value	↓ (**S1**) or ↑ (**S2**), then **ENTER**
Scroll through menu levels or fields	← (**S3**) or → (**S4**)
Print a report or label*	Station key, **Print**, ↑ or ↓ (to select format), then **ENTER**
Discard changes or go back in menu	**Esc**

*You can also print a report or label using the menu. Refer to ***Printing Report or Label***.

Function Keys

Press	To
Fn-**5**	View number of batteries serviced
Fn-**7**	View firmware version
Fn-**8**	Calibrate adapter/station*

*You can also calibrate adapter/station using the menu. Refer to ***Calibrating Station*.**

Lights (LEDs)

Light	Status	Explanation
RUN (Yellow)	on	Service completed.
READY (Green)	on	Service in progress.
	flashing	Cold battery. Service resumes when battery warms up (Code 12).
FAIL (Red)	on	Battery failed.
	flashing	Hot battery. Service resumes when battery cools down (Code 13).
All	flashing randomly	System failed. Turn off the analyzer and turn it back on. Contact Cadex if the condition persists.

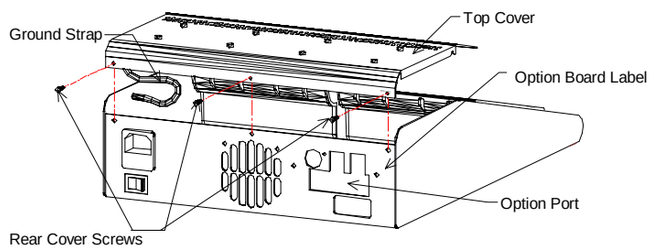
Replacing the Station Fuses

Each station is protected by its own fuse. An open station fuse is identified by the absence of charge or discharge current with a battery in service, and/or a message shown on the display, such as code 160 (Bad fuse or driver).

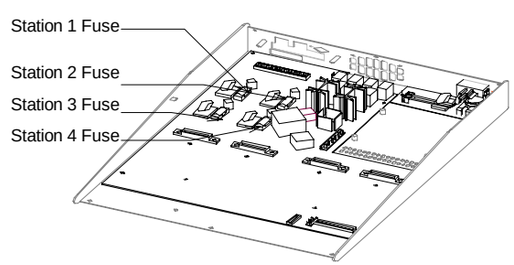
Model	Station Fuse	Size	Replacement	Cadex P/N
All	F2.5 Amp 250V	5 x 20 mm	Littlefuse 217 02.5	52-526-0250

Standard Model (C7000-1, C7000-2, C7000-9)

1. Remove all batteries and adapters, turn off the analyzer and unplug power cord.
2. Unscrew the 3 screws located on the rear. The cover will still be attached to the analyzer by a grounding strap. Put the cover to one side.

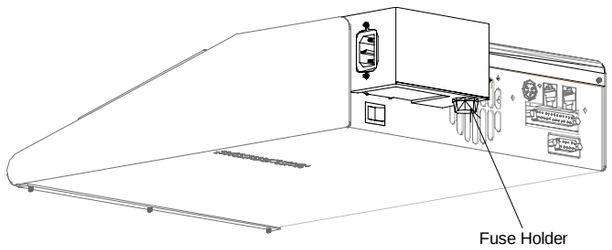


3. Remove the open fuse from the holder, taking care *not to touch any of the electrical components*. The station fuses are located in the left rear corner of the analyzer on the motherboard:



Extended Range Model (C7000ER)

1. Remove all batteries and adapters, turn off the analyzer and unplug the power cord**.**
2. Locate the fuse holder under the rear metal cover extension.



3. Use a small screwdriver to turn the fuse holder clockwise until it is released. Then pull the holder.
4. If the primary (input) fuse needs to be replaced, remove the fuse from the holder and replace the fuse.
5. Insert the fuse drawer taking care that the side springs are inserted into the socket. Turn counterclockwise to close the holder.
6. Insert power cord and turn on the analyzer.

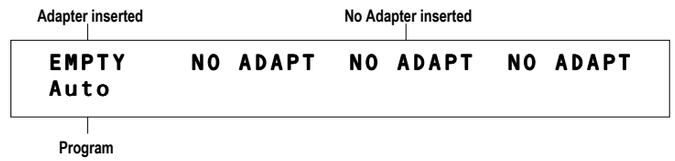
Basic Battery Service

This section covers the basic general procedures on how to service a battery.

1. **Turn the power on and insert the Battery Adapter into a station.**

   - Slide the lower front part of the adapter into the station towards the display. Press the back end down to close the snap lock with a click.

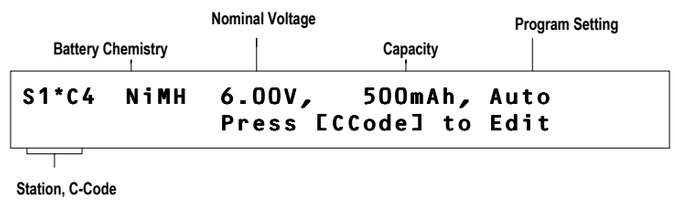
   For example, if you insert the adapter in Station 1, the following is displayed:



2. **Insert the battery into the adapter.** The following message appears on the display when the battery is detected:

Warning: Make sure that the battery contacts are clean before inserting the battery, otherwise melting can occur. To clean the battery contacts, use a lint-free cotton swab dipped in 100% Isopropyl Alcohol.

3. **View the battery configurations (C-Codes)** by pressing the **ENTER** key.



Refer to ***Battery Configuration/C-Codes*** for details on C-Codes.

- If the active C-Code (indicated by the "✱") is correct, proceed to step 7 to start service.

4. **Select the correct C-Code.**

   - Use the ↑ (**S2**) and ↓ (**S1**) keys to scroll through the available C-Codes in the adapter, then press **ENTER** when the correct C-Code is displayed.
   - Press **ENTER** again to confirm the selection. The selected C-Code now becomes active, indicated by the "✱".

   If a Smart Cable Adapter is first used, create a custom C-Code:

   - Press **CCode**.
   - Use the ↑ (**S2**) and ↓ (**S1**) keys to select or the keypad to enter the settings. Advance or go back using the → (**S4**) and ← (**S3**) keys.
   - Press **ENTER** and select **Yes**. Now you can proceed to step 7 to start service.

   Refer to ***Battery Configuration/C-Codes*** to add or edit C-Codes.

Warning: Always use the correct C-Code, especially the correct chemistry. Failure to do so may cause damage to the battery, fire or explosion.

5. **Select a program.** (Refer to ***Battery Service Programs*** for the various programs and their uses.)

   - Press the **PROG** key.
   - Use the ↑ (**S2**) and ↓ (**S1**) keys to scroll through the available programs, then press **ENTER** when the desired program is displayed.
   - Press **ENTER** to confirm the selection. To cancel, press **Esc**.

6. **Verify the settings again** after pressing **ENTER**.

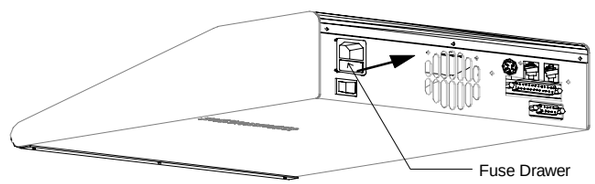
Replacing the Primary (Input) Fuse

If the analyzer does not power up but the input line is checked and power cord is firmly inserted, the primary (input) fuse may need to be replaced.

Model	Primary Fuse	Size	Replacement	Cadex P/N
C7000-1	T1.6 Amp 250V	5 x 20 mm	Schurter 034.3119	52-546-0160
C7000-2	T1.6 Amp 250V	5 x 20 mm	Schurter 034.3119	52-546-0160
C7000-9	T0.8 Amp 250V	5 x 20 mm	Bussman GDC800mA	52-546-0080
C7000ER	T3.5 Amp 250V	5 x 20 mm	Littlefuse 216 31.5	52-546-0315

Standard Model (C7000-1, C7000-2, C7000-9)

1. Remove all batteries and adapters, turn off the analyzer and unplug the power cord**.**
2. Locate the fuse drawer below the power cord socket.



3. Open the fuse drawer by pulling the release tab outward with a fingernail or small screwdriver.
4. If the primary (input) fuse needs to be replaced, remove the fuse from the fuse drawer and replace the fuse.
5. Push the release tab back to the fuse drawer until it clicks shut.
6. Insert the power cord and turn on the analyzer.

Services and Upgrades

Caution

- Unauthorized disassembly and/or repair of the analyzer by other than an authorized Cadex Service Center will void the warranty.
- Observe anti-static precautions before and during service. The circuitry used in the analyzer is sensitive to electrostatic discharge and may be damaged if not handled properly. Static charge is generated through the contact of non-conductive materials such as plastic bags, synthetic clothing and carpeted floors.
- It is recommended that a grounded wrist and/or foot band be used when dismantling the analyzer. If a wrist or foot band is not available, firmly grasp the metal edge of the RS-232 Serial Port before touching any components. Repeat often during service.

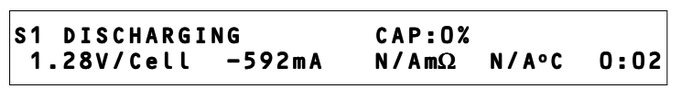
Warning

- Before performing any service, remove all Battery Adapters, turn off the analyzer, and disconnect the power cord.
- For C7000ER, a high voltage is present on the power supply circuit board and the capacitors for at least 30 minutes after the power switch is turned off. To ensure satisfactory discharge of energy, allow the analyzer to sit for at least 30 minutes before removing the chassis cover.

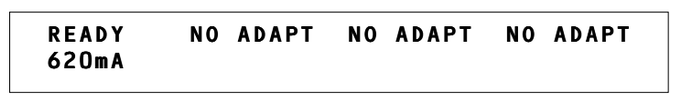
7. **Start service** by pressing **ENTER**.

   The analyzer will now proceed through the instructions in the selected program. The display and lights show the status of the process:

   ▶ To view details, press the station key.



8. **Service is complete.**



   ▶ To view details, press the station key.

   ▶ To remove the adapter, press the latch-bar behind the label and lift the adapter upwards.

Servicing Batteries with Bar Code

This applies when the analyzer is equipped with the OP-72 option board which supports a bar code reader.

1. Print Bar Code Labels: one with Battery ID, one with C-Code. (Refer to ***Print Utilities*** for detailed procedures.)
2. Place the labels onto the battery.
3. With the Battery Adapter inserted, select the station by pressing the station key.
4. Scan the Battery ID.
5. Scan the C-Code.
6. When the READY (green) light flashes, insert the battery and press **ENTER** to start service.

   Note that the active C-Code displayed is *C11*, a read-only position in the adapter reserved for bar code entries.

Code	Detail	Global
162	DISCHARGE CURRENT LOW	FAIL 162
164	CHARGE CURRENT LOW	FAIL 164
170	CALIBRATION FAULT	FAIL 170
188	SUSPENDED PROCESS ABORTED	INTERRUPT
192	CELL MISMATCH CORRECTED	READY
195	CAP. IMPROVED TO TARGET	READY
200	POWER ON	POWER ON
201	ADAPTER INSERTED	ADAPT IN
202	ADAPTER REMOVED	ADAPT OUT
207	TEMPERATURE HOLD - COOLING	SYS-TEMP
208	ADAPTER NOT SETUP	FAIL 208
209	ADAPTER DATA INVALID	FAIL 209
210	BAD ADAPTER	FAIL 210
211	NULL C-CODE IN ADAPTER	FAIL 211
212	PIC COMMUNICATIONS ERROR	PIC ERROR

Code	Detail	Global
031	DISCHARGE CYCLE COMPLETE	END CYCLE
032	CYCLE RESUMED	RESUMED
033	USER PROGRAMMED TIMEOUT	END CYCLE
034	BATSHOP MODE WAIT	BATSHOP
035	SM-BUS ADAPTER INSERTED	SM ADP IN
036	SMART BATTERY INSERTED	SM BAT IN
112	CELL MISMATCH	WARNING
113	PLATEAU TIMEOUT	WARNING
115	TARGET CAPACITY NOT MET	WARNING
118	SOFT BATTERY STEP DOWN	WARNING
120	OVER VOLTAGE	FAIL 120
121	SHORTED OR REVERSED	SHORT/REV
122	BATTERY SHORTED	FAIL 122
123	LOW VOLTAGE TIMEOUT 1	FAIL 123
124	LOW VOLTAGE TIMEOUT 2	FAIL 124
125	NO SLOPE TIMEOUT ZONE 1	FAIL 125
126	LOW VOLTAGE NEGATIVE SLOPE	FAIL 126
127	LOW VOLTAGE TIMEOUT 3	FAIL 127
128	SOFT BATTERY	FAIL 128
129	INTERMITTENT BATTERY	FAIL 129
130	CURRENT RISE	WARNING
135	RESISTANCE THRS. EXCEEDED	FAIL 135
142	DISCHARGE TIMEOUT	FAIL 142
144	CHARGE TIMEOUT	FAIL 144
146	RECONDITION TIMEOUT	WARNING
150	THERMISTOR FAILURE	FAIL 150
152	LOW VOLTAGE TEMP. RISE	FAIL 152
154	CHRG COMPLETE TEMP. RISE	WARNING
156	HOT AT LOW VOLTAGE	FAIL 156
158	CHARGE COMPLETE HOT	WARNING
159	TRICKLE CHARGE OVERHEAT	FAIL 159
160	BAD FUSE OR DRIVER	FAIL 160

Battery Service Programs

The Cadex analyzer can be programmed with any combination of service functions to suit special battery needs. The 10 pre-programmed service programs combine discharge, charge, recondition, and resistance test to achieve results as required.

Basic Programs

The basic programs include **Auto**, **Charge** and **Prime**. Each program performs functions for different purposes:

	Function	Use
Auto	Exercises batteries to maintain optimum performance. If the Target Capacity cannot be reached, recondition is applied.	Restore batteries affected by "memory". Routine battery maintenance. Identify marginally performing batteries. Service batteries in unknown condition. Verify battery condition for warranty claim.
Charge	Applies fast charge. No capacity readings are taken and no discharge is applied.	Fast charge. Topping up of partially discharged or partially used batteries.
Prime	Repeatedly cycles battery until maximum capacity is reached. If capacity improvement is more than 5% over previous reading, an additional cycle is applied.	Prepare new batteries for field use. Condition batteries that have been in storage. ***Warning: Do not store Smart Batteries in discharged state.****

**** If the voltage drops below the level required by the processor within the Smart Battery, information can be lost. In some cases, this can cause the battery to become non-operative.***

Specialty Programs

Specialty programs include **OhmTest**, **Runtime**, **Self-Discharge**, **Life-Cycling**, **Discharge Only**, **Extended Prime**, and 4 programmable Custom Programs.

	Function	Use
OhmTest	Tests internal resistance against the user definable Resistance Threshold. Passes or Fails the battery.	Check if the battery is in good condition. Determine if the battery requires to be further analyzed.
Runtime	Measures length of time a battery can provide a given current and remain above its End of Voltage. Runtime Cycles are editable.	Tests runtime of batteries for wireless communications equipment.
Self-Discharge	Reads fully charged battery capacity, recharges and reads the capacity again after a user definable wait period. If the second reading is lower by 30% or more, the battery is failed.	Identify high self discharge on batteries that otherwise may have good capacity readings.
Life-Cycling	Continuously cycles battery until capacity drops below Target Capacity. Displays initial and final capacity, OhmTest result and self discharge readings (if self discharge is included).	Verify battery life cycle. Estimate performance time.
Discharge Only	Discharges a battery to its End of Discharge voltage.	Determine residual capacity of battery. Prepare batteries for storage. ***Warning: Do not store Smart Batteries in discharged state (See * on p.21)*** Determine battery performance under load.
Extended Prime	Applies a 16 hour trickle charge, followed by cycling to obtain peak capacity.	Recommended for new batteries or batteries in extended storage.
Custom 1, 2, 3, 4	Fully programmable by the user. See ***Custom Programs***.	Accommodate special needs.

By Code

The codes are listed in ascending numeric order and cross-referenced to both the Detail and Global display. Refer back to ***By Detail*** for possible reason(s)/solution(s).

Code	Detail	Global
000	STATION OFF LINE	OFFLINE
001	NO ADAPTER	NO ADAPT
002	CHARGING	CHARGE
003	TRICKLE CHARGE	TRKL CHRG
004	RECONDITIONING	RECOND
005	READY	READY
006	DISCHARGE WAIT	DCHG WAIT
007	DISCHARGING	DISCHARGE
008	INSERT THE BATTERY	INSERT
009	CHARGE WAIT	CHG WAIT
010	NO BATTERY	EMPTY
011	START BATTERY PROCESSING	START
012	BATTERY TOO COLD	COLD WAIT
013	BATTERY TOO HOT	HOT WAIT
014	BATTERY OVER TEMP	OVERHEAT
015	PROCESS COMPLETED	FINISHED
016	PROGRAM FAULT DETECTED	WARNING
017	BATTERY REMOVED	REMOVED
018	PROCESS SUSPENDED	INTERRUPT
019	RESTING XX:XX	RESTING
020	BATTERY INSERTED	INSERTED
021	RESTING XX:XX	RESTING
022	SETTING UP CALIBRATION	CAL WAIT
023	STATION CALIBRATING	CALIBRATE
026	BATTERY REMOVED	REMOVED
027	RESISTANCE TEST	OHMTEST
028	RESISTANCE TEST	OHMTEST
029	CALIBRATE	CALIBRATE
030	CHARGE CYCLE COMPLETE	END CYCLE

	Detail	Global	Possible Reason(s) / Solution(s)
	Thermistor failure	FAIL 150	Battery or adapter thermistor is open or shorted. Clean the contacts on the battery. Warm the battery to room temperature. The battery thermistor may be damaged. Use another good battery to check and discard battery if damaged. If the battery is still good and code 150 (Thermistor failure) appears, contact Cadex Service.
	Trickle charge	TRKL CHRG	The reconditioning process completed and the battery is being recharged. The program has specified a trickle charge.
	Trickle charge overheat	FAIL 159	The temperature on the battery has risen over its maximum setting. The trickle charge stops. The Trickle Charge rate or the Max. Standby voltage in the Extended C-Code may have to be reduced. Check that the mAh rating of the battery matches the C-Code mAh setting. Lower the room temperature. For non OEM battery, turn off temperature sensing.
U	User programmed timeout	END CYCLE	The time programmed in the Custom Program completed. The program is moving into the next step.

Target Capacity

Target Capacity is the percentage of the battery capacity compared to the nominal capacity. It serves as the threshold for reconditioning a battery in the **Auto** program.

The Target Capacity can be set between 50% and 150%. Following are the recommended values:

90% Maintains batteries for critical applications which require maximum energy reserve and high reliability. Fewer batteries will pass.

80% Recommended (default) setting which provides a balance between adequate energy reserve and long service life.

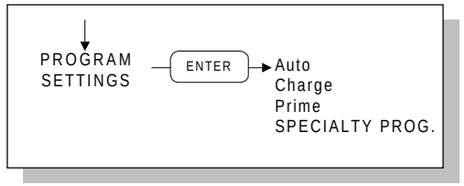
70% Recommended for less stringent applications where battery power demand is not critical or is of brief duration. More batteries will pass.

Target Capacity is a pass/fail mark and does not affect the final charge level. For example, a battery with a 90% capacity will pass if the Target Capacity is 80% but fail if the Target Capacity is 100%. The batteries are always fully charged.

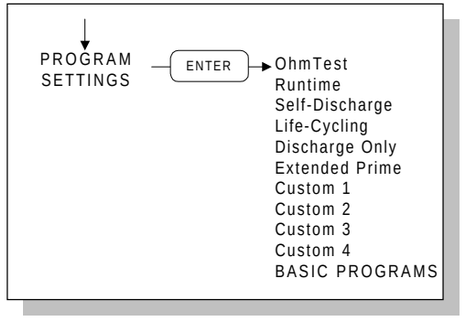
Selecting a Program or Setting Target Capacity

The following procedures describe how to select a program and/or set the Target Capacity *before* a battery is inserted. To select a program and/or set the Target Capacity when a battery is inserted for service, follow the procedures in ***Basic Battery Service***.

1. Press the station key, then use the ↑ and ↓ keys to find the C-Code for which you want to select the program and/or set the Target Capacity.
2. Press **Prog**.
3. Select the desired program, depending on which program list you are in:
   - If you are in the Basic Program list



   - If you are in the Specialty Program list



4. Set the Target Capacity using the keypad or ↑ and ↓ keys.
5. Press **ENTER** to confirm.

	Detail	Global	Possible Reason(s) / Solution(s)
	Soft battery step down	WARNING	Battery voltage rising too quickly while charging. Analyzer is cutting the Charge rate in half and will attempt to complete service at lower current rate. Wait until processing is complete. If voltage rises again, code 118 (Soft battery) will appear and the program terminated. Charge rate in the Extended C-Code may have to be reduced. If the battery is new or in storage, use the **Prime** program.
	Start battery process	START	Battery service has started.
	Station calibrating	CALIBRATE	Station is in calibration. Process takes about 10 seconds.
	Station off line	OFFLINE	Station is not reading the adapter. Remove the adapter and restart the analyzer. Delete the C-Code that was selected for the battery. Make sure all your analyzers have the same firmware version number. Press **Alt-0** to reset the system.
	Suspended Process Aborted	INTERRUPT	Battery is removed during service for more than 5 seconds. Program terminated.
			For non OEM battery, turn off temperature sensing.
T	Target capacity not met	WARNING	Final capacity of the battery is below the Target Capacity. The analyzer will attempt to improve the capacity by reconditioning the battery. Wait until processing is complete. The **Auto** and **Prime** programs will attempt to correct this warning. If corrected, code 195 (Cap. improved to target) will appear. Check that the mAh rating of the battery matches the C-Code mAh setting. Battery may be old and operating time will be less than manufacturer's specification.
	Temperature hold - Cooling	SYS-TEMP	This is normal. All cycles are briefly suspended due to high temperature inside the analyzer. Service will resume in a few minutes or after the board has cooled. This may occur a number of times per hour. If it reoccurs continually, move the analyzer to a cooler room.

Detail	Global	Possible Reason(s) / Solution(s)
Resistance test	OHMTEST (Code 27)	A manually selected or programmed resistance test for the battery is in progress. Program completes in 5 seconds.
Resistance test	OHMTEST (Code 28)	An automatic resistance test under the **Life Cycling** program is in progress. The program should complete in 5 seconds.
Resistance thrs. Exceeded	FAIL 135	The battery resistance has exceeded the set resistance threshold in **OhmTest**. Program has terminated.
Resting XX:XX	RESTING (Code 19)	Station is in rest period as specified in the Custom Program.
Resting XX:XX	RESTING (Code 21)	Station is in an automatic rest period specified in the **Charge** program for NiMH batteries. The procedure is automatic if temperature sensing for the adapter is not enabled.
Setting up calibration	CAL WAIT	Station is preparing for a calibration process.
Shorted or reversed	SHORT/REV	Battery voltage is too low on insertion. Battery may be connected backwards in the adapter. Ensure battery leads are connected properly. Battery may be fully discharged. Recharge battery in its original charger before placing it in the analyzer. Battery may have shorted cells. Discard the battery.
SM-Bus adapter inserted	SM ADP IN	SMBus Adapter is detected on a station.
Smart battery inserted	SM BAT IN	Smart battery is detected on a SMBus Adapter.
Soft battery	FAIL 128	Battery voltage is rising quickly during charging, even after code 118 (Soft battery step down). Processing has terminated. Battery may be overcharged. Discharge the battery for 10 minutes, then charge again. Battery may be a high capacity type battery. Reduce the Charge rate. Battery is new. Use the **Prime** program to prepare the battery for use. Check that correct contacts are used.

S

Editing Program Settings

Only the following program settings can be edited:

- Threshold of internal resistance in **OhmTest**
- Wait period in **Self-Discharge**
- Inclusion of **Self-Discharge** test in **Life-Cycling**
- Cycle time and load current in **Runtime**
- Custom Programs (refer to ***Custom Programs***)

1. Select **Program Settings** on the menu. Refer to ***Menu***.
2. Select the program to edit.
3. Press **Prog**, then edit the program settings.
   - Use the ↑ and ↓ keys to select or the keypad to enter the new settings. Advance or go back using the → and ← keys.
4. Select **Yes** to accept changes.

Duration of Service

The following table displays the approximate service times at default Charge/ Discharge rates.

	NiCd and NiMH	SLA	Li-Ion
Auto	2.5-10 hours	20-40 hours	6-20 hours
Charge	1.5 hours	10 hours	4 hours
Prime	5-10 hours	40-80 hours	12-25 hours
OhmTest	5 seconds	5 seconds	5 seconds
Runtime*	-	-	-
Self Discharge	30 hours	60 hours	50 hours
Life Cycling	1500 Cycles (NiCd) 500 Cycles (NiMH)	200-500 Cycles	1000 Cycles
Discharge Only	1.5 hours	20 hours	4 hours
Extended Prime	21-26 hours	56-96 hours	28-41 hours
Custom 1, 2, 3, 4	-	-	-

* Duration depends on settings.

	Detail	Global	Possible Reason(s) / Solution(s)
O	Over voltage	FAIL 120	Battery voltage is too high on insertion. Discharge the battery in its original equipment. Check the electrolyte. If all fails, discard the battery.
P	PIC communications error	PIC ERROR	An internal communication error has occurred inside the analyzer. Turn off and turn on the analyzer or press **Alt**-**0** to reset the system.
	Plateau timeout	WARNING	Battery was fully charged before full-charge conditions were met. For SLA and Li-Ion batteries only. The End of Charge setting in the C-Code may have to be increased. Battery may be old and operating time will be less than manufacturer's specifications.
	Power on	POWER ON	Power is detected inside the analyzer.
	Process completed	FINISHED	Battery service completed.
	Process suspended	INTERRUPT	Battery is removed during service. Re-insert battery within 5 seconds to resume service.
	Program fault detected	WARNING	The Custom Program has produced an error and the **Next** statement is not processed. The program is terminated. Check the Custom Program statements.
R	Ready	READY	Battery is ready. Faults or warnings (if any) were corrected. Remove battery and use as normal.
	Recondition timeout	WARNING	Recondition time has exceeded the expected value for the battery. Program proceeds to the next cycle. The Recondition Discharge in the Extended C-Code may have to be raised. The battery may be intrinsically safe, preventing deep discharge. Use I/S settings for the battery. Refer to ***Intrinsically Safe Settings***. Cells are mismatched, or if battery is new, use the **Prime** program.
	Reconditioning	RECOND	Battery is currently being reconditioned.

	Detail	Global	Possible Reason(s) / Solution(s)
	Low voltage temp. rise	FAIL 152	Battery temperature is rising rapidly at low voltage (usually at the initial stage of charge). Charging is terminated. The Charge rate in the Extended C-Code may have to be reduced. The battery may be old or have shorted cells. Discard the battery. For non OEM battery, turn off temperature sensing.
	Low voltage timeout 1	FAIL 123	The battery stopped accepting charge 1 C-minute into the charge cycle. See code 122, Battery shorted.
	Low voltage timeout 2	FAIL 124	The battery stopped accepting charge 10 C-minutes into the charge cycle. See code 122, Battery shorted.
	Low voltage timeout 3	FAIL 127	Charge terminated. Correct voltage could not be obtained in allotted time due to high battery capacity for set charge current, incorrect voltage setting or shorted cells. Check C-Code settings and battery rating. Replace battery if low voltage remains.
N	N/A mΩ	-	**OhmTest** has not been performed yet so no resistance reading is available.
	No adapter	NO ADAPT	No Battery Adapter is inserted or the inserted adapter is not detected. Check contacts. Clean with a lint-free cotton swab dipped in 100% Isopropyl Alcohol.
	No battery	EMPTY	No battery is inserted or the inserted battery is not detected. Check contacts. Turn on battery switch if applicable. Check for correct battery for the adapter and adapter contacts. Clean all contacts.
	No slope timeout zone 1	FAIL 125	The battery is losing charge faster that it is being supplied in the initial charge cycle. For SLA and Li-Ion batteries only. The Charge rate in the C-Code may have to be increased. If all fails, discard the battery.
	Null C-Code in adapter	FAIL 211	An empty C-Code is selected. Select a programmed C-Code or program the selected empty C-Code.

Battery Configuration/C-Codes

Configuration Codes, or C-Codes, are battery parameters to service a battery. Battery Adapters are pre-programmed with the available C-Codes for that battery type. The adapters store C-Codes once entered and can be moved between stations.

A maximum of 10 C-Codes can be stored, allowing you to conveniently service all battery types. The unused positions (Null Codes) remain empty and can be programmed. You can view, select, create, copy and edit a C-Code. Refer to ***Managing C-Codes***. Note that *the C-Code in active service cannot be edited*.

When a Smart Cable Adapter is first used, the "NULL" status appears on the display. You will need to create a custom C-Code before servicing. Refer to ***Managing C-Codes*** on how to create a C-Code.

A C-Code is divided into 2 parts:

- **Basic C-Code** that includes chemistry, voltage and capacity.
- **Extended C-Code** that consists of Charge/Discharge C-rates, Trickle Charge rate, recondition settings, and other parameters specific to the battery. *Extended C-Code parameters are preset to default settings and normally do not need to be changed.*

Basic C-Code

Parameter	Description
Chemistry	Often labeled on the battery, refers to the battery type. Includes Nickel Cadmium (NiCd), Nickel Metal Hydride (NiMH), Sealed Lead Acid* (SLA), and Lithium Ion (Li-Ion).
Battery Voltage	Terminal voltage of the battery. Voltage range depends on the model and chemistry. Refer to ***Specification: Firmware***.
Battery Rating (Capacity)	Capacity (mAh) specified by the manufacturer. Ranges from 100mAh to 24,975mAh in increments of 25mAh.

*The battery types of SLA are Gell (for most batteries) and Hawker (for cylindrical SLA batteries manufactured by Hawker).

Extended C-Code

Parameter	Description
Charge Rate	A 1000mAh capacity with a charge current of 500mA will have a Charge C-rate of 0.50C. A lower Charge C-rate reduces the charge current and increases service time. The maximum charge current is 2000mA (2A).
Discharge Rate	A 1000mAh capacity with a discharge current of 500mA will have a Discharge C-rate of 0.50C. A lower Discharge C-rate reduces the discharge current and increases service time.The maximum discharge current is 2000mA (2A).
Trickle Charge Rate (NiCd and NiMH only)	Amount of trickle applied to maintain the charge on a battery after service. From 1% to 10% in increments of 1%.
Recondition Discharge Rate (NiCd and NiMH only)	A slow and gradual discharge after the battery reaches the End of Discharge voltage. During this process, the crystalline build-up (memory) on the cell plates dissolves and the battery often restores itself. From 2% to 20% in increments of 2%.
Capacity Offset	Adjusts the capacity readings when discharging a battery at a higher or lower C-rate than specified by the manufacturer. Mainly used for SLA batteries. From -50% to +49% in increments of 1%.
Temperature Sensing	The temperature range in which a station will service the battery. Effective only for batteries or adapters equipped with temperature sensor.
Negative Slope (NiCd and NiMH only)	A measure of the voltage drop when the battery reaches full-charge. The charge cycle is terminated when the voltage drop reaches the set value. From 16 to 64mV/Cell.

	Detail	Global	Possible Reason(s) / Solution(s)
	Discharge timeout	FAIL 142	Battery capacity has exceeded 250% of the rated capacity. Check that the mAh rating of the battery matches the C-Code mAh setting. The Discharge rate in the Extended C-Code may have to be raised.
	Discharge wait	DCHG WAIT	Station is on hold until sufficient power is available. Wait until other stations have completed battery service.
	Discharging	DISCHARGE	Battery is being discharged normally.
H	Hot at low voltage	FAIL 156	Battery temperature went to its maximum setting in the initial charge cycle. Cool the battery to the service temperature. Raise the temperature sensing in the C-Code.
			The internal cells may have shorted or the battery is old. Either monitor battery use or discard.
			For non OEM battery, turn off temperature sensing.
I	Insert the battery	INSERT	Insert battery into the station.
	Intermittent battery	FAIL 129	Battery connection opened 5 times in 1 minute. Check and clean the battery contacts. Check that correct contacts are used. Check that the battery is properly inserted. The Charge rate in Extended C-Code may have to be reduced.
			Protection circuitry opened at End of Discharge voltage. Raise End of Discharge voltage.
			For intrinsically safe battery, use I/S settings. Refer to ***Intrinsically Safe Settings***.
L	Low voltage negative slope	FAIL 126	The battery is losing charge faster than it is being supplied into the battery in the initial charge cycle. For NiCd and NiMH batteries only. The Charge rate in the C-Code may have to be reduced.
			If battery is a high capacity NiCd, reduce the Charge rate to 0.5C. Otherwise reduce to 0.6C.
			If all fails, discard the battery.

Detail	Global	Possible Reason(s) / Solution(s)
Charge timeout	FAIL 144	Charge time has exceeded the expected value for the battery. Check that the mAh rating of the battery matches the C-Code mAh setting. The Charge rate in the Extended C-Code may have to be raised.
Charge wait	CHG WAIT	Station is on hold until sufficient power is available. This is normal if large batteries are being serviced. Service will automatically resume when sufficient power is available to the station.
Charging	CHARGE	Battery is being charged normally.
Chrg complete temp rise	WARNING	Battery is being charged normally but temperature is rising rapidly towards its end of charge state. Wait until processing is complete. An appropriate WAIT code may appear until the battery has cooled before the next process begins. The Charge rate in the Extended C-Code may have to be lowered. Observe battery performance. The battery may be old. For non OEM battery, turn off temperature sensing.
Current rise	WARNING	Generally for SLA only. Battery current suddenly increased as the End of Charge condition was achieved. If the SLA battery is a Hawker cell, use the Hawker C-Code settings (refer to ***Default Settings for Extended C-Codes***). Allow the station to complete service.
Cycle resumed	RESUMED	Power resumed or the battery is re-inserted into the adapter.
D Discharge current low	FAIL 162	The analyzer is not able to discharge the battery. Very low values of current (< 50mA) are displayed on the analyzer before this code appears. See code 160, Bad fuses or driver.
Discharge cycle complete	END CYCLE	Discharge cycle completed. Program is going into the next step.

Parameter	Description
End of Discharge	The threshold point at which the discharge cycle is terminated. Chemistry dependent. Available settings: 0.76-1.12V/Cell (NiCd, NiMH); 1.36-1.95V/Cell (SLA); 2.30-3.20V/Cell (Li-Ion).
End of Recondition (NiCd and NiMH only)	The threshold point at which the reconditioning cycle is complete. Available settings: **Disabled** or 0.40-0.80V/Cell.
Charge Method (NiCd and NiMH only)	Allows setting of Reverse Load. The Reverse Load method intersperses discharge pulses between charge pulses to keep batteries cool and promotes the recombination of gases. Available settings: **DC Charge**, **No Rev Load**, **Rev Load** 5-12%.
Max. Standby Voltage (SLA and Li-Ion only)	Maintains the battery at full charge state after service is complete. Available settings: 2.15-2.45V/Cell (SLA); 3.90-4.35V/Cell (Li-Ion).
Max. Charge Voltage (SLA and Li-Ion only)	The threshold point at which the analyzer stops charging the battery. At this point, the current charge drops while maintaining the Max. Charge Voltage. Available settings: 2.20-2.65V/Cell (SLA); 3.90-4.35V/Cell (Li-Ion).
End of Charge (SLA and Li-Ion only)	Detects full charge state. When the End of Charge condition is reached (Charge rate difference is less than the specified value), the battery is considered fully charged and the analyzer completes the charge cycle on the battery. From 0.01 to 0.10C.

Viewing C-Codes

- Press the station key, then use the ↑ and ↓ keys to scroll through the Basic C-Codes and the → and ← keys to view the Extended C-Code parameters.

Managing C-Codes

- Press the station key to display the Basic C-Code, then:

To	Procedures
Select a C-Code	Scroll to the C-Code with the ↑ and ↓ keys, then press **ENTER** and select **Yes**. The "✱" appears beside the C-Code number on the display.
Edit a C-Code	Scroll to the C-Code with the ↑ and ↓ keys, then press **CCode**. Use the ↑ and ↓ keys or the keypad to change the settings. Advance or go back using the → and ← keys. Then press **ENTER** and select **Yes**.
Delete a C-Code	Scroll to the C-Code with the ↑ and ↓ keys, then press **Fn**-**0** and select **Yes**.
Create a C-Code	Scroll to an empty C-Code with the ↑ and ↓ keys, then press **CCode**. Use the ↑ and ↓ keys to select or the keypad to enter the settings. Advance or go back using the → and ← keys. Then press **ENTER** and select **Yes**. Select **Yes** again to select the new C-Code.
Reset Extended C-Code to default*	Scroll to the C-Code with the ↑ and ↓ keys, then press **Fn**-**1** and select **Yes**.
Copy a C-Code	Scroll to the C-Code with the the ↑ and ↓ keys, then press **Fn**-**3**. Press the station key of the adapter to copy to, scroll to the C-Code (usually an empty one) and press **ENTER**, then select **Yes** again.
Copy all C-Codes to another adapter	Press **Fn**-**6**. Then press the station key of the adapter to copy to and select **Yes**.
Add, edit or erase a battery setup name	Scroll to the C-Code with the ↑ and ↓ keys, then press **Fn**-**7**. Use the ↑ and ↓ keys or the keypad to enter, edit or erase the battery setup name. Advance or go back using the → and ← keys. Then select **Yes**.

*Refer to ***Default Settings for Extended C-Codes***.

C

Detail	Global	Possible Reason(s) / Solution(s)
Calibrate	CALIBRATE	Calibration in process. Process will complete in 10 seconds.
Calibration fault	FAIL 170	Current cannot pass through shorted terminal during calibration. Repeat calibration procedures. An AWG 10 (2.5mm) wire is recommended to short contacts/leads.
Cap. improved to target	READY	Target Capacity is achieved or exceeded after an initial warning (code 115, Target capacity not met).
C-Code locked	C-CODE LOCKED	C-Code is locked and cannot be edited. Use an unlocked C-Code or delete and re-enter the C-Code.
Cell mismatch	WARNING	For NiCd batteries only. The cells reach full charge at different times so the negative slope is not well-defined. The program proceeds to the next cycle as normal. Wait until processing is complete since the **Auto** and **Prime** programs will attempt to correct this warning. If corrected, code 192 (Cell mismatch corrected) will appear. The negative slope in Extended C-Code may have to be increased to 32mV/Cell or more. Battery may be old and operating time is reduced. Either monitor battery use or discard the battery. If the battery is new, use the **Prime** program.
Cell mismatch corrected	READY	Cell mismatch (code 112) is corrected through several Charge/Discharge cycles. Use the battery as normal.
Charge complete hot	WARNING	Battery is fully charged but the temperature is at or above the maximum set value in the C-Code. See code 154, Chrg complete temp rise, for details. For non OEM battery, turn off temperature sensing in the C-Code.
Charge current low	FAIL 164	Current driver cannot provide the requested charge current. See code 160, Bad fuses or driver.
Charge current complete	END CYCLE	Charge cycle completed. Program is going into the next step.

Detail	Global	Possible Reason(s) / Solution(s)
Batshop mode wait	BATSHOP	Battery is detected on an analyzer connected to BatteryShop. Global message should be displayed. If not, check the C-Code in BatteryShop and ensure that all the settings are correct for the battery.
Battery inserted	INSERTED	Battery is detected on an adapter.
Battery over temp	OVERHEAT	Battery is overheated during charge. Station will go to Resting 00:00 (code 19) until the battery cools. If using a non OEM battery, the battery thermistor may be incorrect for the adapter. Turn off temperature sensing in the C-Code. ***Note: For safety purposes, this step is not possible if the C-Code chemistry is Li-Ion. Contact Cadex to upgrade the adapter for your particular battery.***
Battery removed	REMOVED (Code 17)	Battery is removed when the program completed. This message appears instantaneously when the battery is removed.
Battery removed	REMOVED (Code 26)	A 5 second delay after the battery is removed when the program completed.
Battery shorted	FAIL 122	Battery is not accepting charge in the initial charge cycle (the voltage remains low). Check that the battery voltage is above 0.30V/Cell. The Charge rate may have to be lowered. If all else fails, discard the battery.
Battery too cold	COLD WAIT	Battery temperature is below set value when inserted. The battery will automatically start processing when temperature reaches minimum value set in the C-Code. Warm the battery to room temperature. For non OEM battery, turn off temperature sensing in the C-Code. (see code 14, Battery over temp.)
Battery too hot	HOT WAIT	Battery temperature is too hot when inserted. Cool the battery or use the analyzer in a cooler room. For non OEM battery, turn off temperature sensing. (see code 14, Battery over temp.)

Selecting Correct Voltage

The voltage is based on a nominal cell voltage of 1.2V/Cell for NiCd and NiMH, 2V/Cell for SLA and 3.6V/Cell for Li-Ion.

On some NiCd and NiMH batteries, manufacturers may rate their batteries based on 1.25V/Cell rather than 1.2V/Cell. In this case, as an example, the batteries may state 7.5V or 12.5V. To obtain the correct voltage, multiply this voltage by 0.96 to get the correct value to use. Test results are not affected by this change since these voltages are definitions only.

Some manufacturers may state the number of cells of their batteries. To get the correct voltage, multiply the number of cells by the chemistry type. For example, the voltage of a 6 cell NiCd would be 6 x 1.2V = 7.2V. Use 7.2V on the analyzer.

Intrinsically Safe Settings

- Before servicing intrinsically safe (I/S) batteries, select the following settings:
  - Charge method: DC Charge
  - End of Discharge: 0.96V/Cell
  - Charge Rate: 0.10C
  - Discharge Rate: 0.10C

The Charge rate and Discharge rate can be set to higher values to speed up servicing if no fault code appears.

Default Settings for Extended C-Codes

Parameter	Default Settings
Charge	**1.00C** (NiCd) **1.00C** (NiMH) **0.30C** (SLA) **1.00C** (Li-Ion)
Discharge	**1.00C** (NiCd) **1.00C** (NiMH) **0.10C** (SLA - Gell), **0.40C** (SLA - Hawker) **1.00C** (Li-Ion)
Trickle Charge Rate	**5%** (NiCd) **2%** (NiMH)
Recondition Discharge Rate	**12%** (NiCd, NiMH)
Capacity Offset	**0%**
Temperature Sensing	**Disabled** (adapters without temperature sensor) **0-45ºC** (NiCd, NiMH, SLA) **5-45ºC** (Li-Ion)
Negative slope	**32mV/Cell** (NiCd) **16mV/Cell** (NiMH)
End of Discharge	**1.00V/Cell** (NiCd, NiMH) **1.75V/Cell** (SLA - Gell), **1.62V/Cell** (SLA - Hawker) **3.00V/Cell** (Li-Ion)
End of Recondition	**0.40V/Cell** (NiCd, NiMH)
Charge Method	**Rev Load 9%**
Max. Standby Voltage	**2.25V/Cell** (SLA - Gell), **2.35V/Cell** (SLA - Hawker) **4.05V/Cell** (Li-Ion)
Max. Charge Voltage	**2.40V/Cell** (SLA - Gell), **2.60V/Cell** (SLA - Hawker) **4.20V/Cell** (Li-Ion)
End of Charge	**0.05C** (SLA, Li-Ion)

By Detail

	Detail	Global	Possible Reason(s) / Solution(s)
	>2000 mΩ	-	Resistance of battery is too high. Discharge battery before performing the **OhmTest**.
A	Adapter data invalid	FAIL 209	Invalid value in selected C-Code. Modify the C-Code or delete and re-enter the C-Code.
			The C-Code is not compatible with the firmware; the adapter could have been configured with a newer firmware. Delete and re-enter the C-Code, reset the Extended C-Code to default values or upgrade the analyzer with the latest firmware.
	Adapter inserted	ADAPT IN	Adapter is detected on a station. Global message should be displayed. If not, remove and re-insert adapter.
			If the message persists, re-enter the C-Code.
	Adapter not set up	FAIL 208	Adapter is not programmed with a C-Code or the C-Code is invalid. Re-enter a C-Code.
	Adapter removed	ADAPT OUT	Adapter is removed from a station. If message persists, press **Esc**.
B	Bad adapter	FAIL 210	Adapter is not recognized by the analyzer. Remove and re-insert the adapter. Clean the gold contacts on the underside of the adapter.
			Reset the Extended C-Code to default values or delete and re-enter a C-Code.
	Bad fuse or driver	FAIL 160	The analyzer is not able to supply current to the battery through its current drivers. Very low values of current (about 0mAh) may be displayed on the analyzer before this code appears and processing stops. Check and replace the station fuse. If fuses are ok, then the current drivers could have failed on the analyzer. Before calling Cadex for service, check the following items for other causes of faults:
			Ensure that battery and adapter contacts are clean.
			Verify that mAh rating of the battery matches the C-Code mAh setting.
			The battery may not be able to accept the current load. Lower or raise the Charge rate in the Extended C-Code.
			The battery may be intrinsically safe. Use I/S settings. Refer to ***Intrinsically Safe Settings***.
			Try a different battery in the same station.

Messages and Warnings

This section describes all the messages and warnings that can appear on the display.

Global message is the first message that appears, usually with the **Code**. For example,

- To view the **Detail** message, press the Station key.

When you get a message or warning, you can look into the possible reason(s) and solution(s) by detail or code number.

Custom Programs

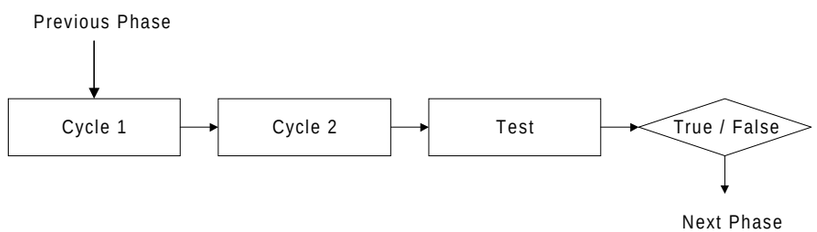
Warning: Creating a Custom Program requires a good understanding of rechargeable batteries and the analyzer. Applying routines that conflict with the battery manufacturer's specifications or recommendations can damage a battery.

If you regularly modify Custom Programs, we strongly recommend BatteryShop. The graphical user interface of BatteryShop allows easy programming. Refer to BatteryShop Help for detailed instructions.

Custom Programs run virtually any sequence of service cycles. They are stored in the analyzer and can be assigned to any C-Codes in the adapters.

A Custom Program consists of 6 phases: **Phase 1**-**5** and **Phase Done**.

- Each of the first 5 phases consists of 2 cycles (**Cycle 1** and **Cycle 2**), **Test** and the **True** and **False** statements.



- **Phase Done** consists of one cycle.

The analyzer will go through the first phase, then follow the paths taken by the decision making **True** and **False** statements in each phase. The following lists describe values allowed for the cycles, the **True** and **False** statements and the **Done** phase.

Cycle 1 and Cycle 2

Option	Description
Skip Cycle	Skip the cycle and go to the next cycle or the **Test** statement.
Discharge Time (**Discharge for *000:00:00* @*100*%**)	Discharge the battery for the specified time period (in hhh:mm:ss format)* at the specified setting. A setting of 50% will give a discharge current that is 50% of the Discharge rate. The Discharge rate is *set in the Extended C-Code*.
Charge Time (**Charge for *000:00:00***)	Charge the battery for the specified time period (in hhh:mm:ss format)*. The Charge rate is *set in the Extended C-Code*.
Recondition Time (**Recondition for *000:00:00***)	Recondition (Deep discharge) the battery for the specified time period (in hhh:mm:ss format)*. The Reconditioning Discharge rate is *set in the Extended C-Code*. This cycle will be skipped for SLA or Li-Ion as these chemistries cannot be reconditioned. *This cycle can only be applied after a discharge cycle.*
Trickle Charge Time (**Trickle Chg for *000:00:00***)	Trickle charge the battery for the specified time period (in hhh:mm:ss format). The Trickle Charge rate is *set in the Extended C-Code* and only applies to NiCd/NiMH.
Rest Time (**Rest for *000:00:00***)	Apply no current for the specified time period (in hhh:mm:ss format). *The time must be specified or the cycle will be skipped.*
OhmTest	Perform the **OhmTest** on the battery. In this case, the resistance threshold is *not* definable.

*If the default time period of 000:00:00 is used, the analyzer will service the battery according to End of Charge, End of Discharge or End of Recondition set in the Extended C-Code.

Log Events

Log Event	Description
Errors	Problems that stop the service.
Warnings	Problems that do not stop the service, but may affect the battery performance.
System Events	Events recorded by the system.
Battery Events	Battery completion events in the battery's service cycle.
Battery Cycles	Detailed events in the battery's service cycle.
Echo to Printer	Whether to send the events to the printer.

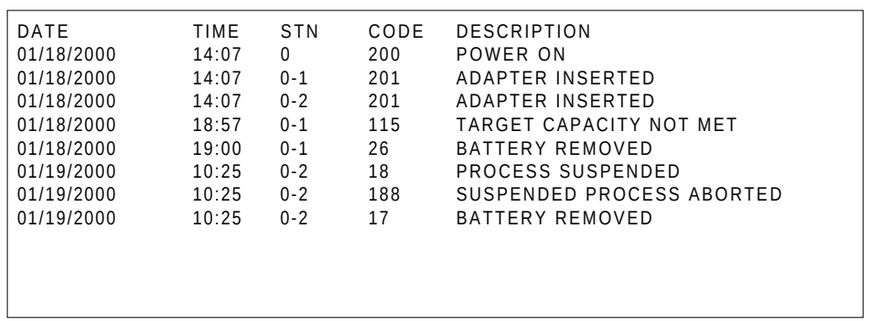
Managing Event Log

- Select the feature on the menu.
  - To view the event log, use the ↑ and ↓ keys to scroll through. When you reach the end of the log, you can go back to the first event by pressing the ↑ key twice. Press **Esc** to exit.
  - To clear the event log, select **Yes** to confirm. To cancel, press **Esc**.
  - To specify events to log, select **Yes** to activate or **No** to de-activate. Use the → and ← keys to toggle between the events. Then select **Yes** to accept changes.

Event Log

The Event Log stores the last 50 selected event data for later viewing or printing. This allows tracking of general battery service trends, identification of potential problems, and tracing battery or system events.

Feature	Description
View Event Log	View the last 50 events in the event log.
Print Event Log	Print the event log.
Clear Event Log	Clear all events in the event log.
Events to Log	Specify events to record or ignore.



DATE	TIME	STN	CODE	DESCRIPTION
01/18/2000	14:07	0	200	POWER ON
01/18/2000	14:07	0-1	201	ADAPTER INSERTED
01/18/2000	14:07	0-2	201	ADAPTER INSERTED
01/18/2000	18:57	0-1	115	TARGET CAPACITY NOT MET
01/18/2000	19:00	0-1	26	BATTERY REMOVED
01/19/2000	10:25	0-2	18	PROCESS SUSPENDED
01/19/2000	10:25	0-2	188	SUSPENDED PROCESS ABORTED
01/19/2000	10:25	0-2	17	BATTERY REMOVED

Event Log

Test

Test provides the condition for selecting the **True** or **False** statement.

Option	Description
Skip Test	Go to the **True** statement. The **False** statement is ignored.
IF Target Capacity Met	If the capacity during the last discharge cycle meets the Target Capacity, go to the **True** statement. Otherwise the **False** statement is selected.
IF Target Capacity Not Met	If the capacity during the last discharge is below the Target Capacity, go to the **True** statement. Otherwise the **False** statement is selected.
IF < 5% Capacity Increase	If the improvement in capacity during the last two discharge cycles is less than 5% (for example, the last one is 88% and the one before is 85%; or 80% and 90%), go to the **True** statement. Otherwise (for example, 90% and 80%) the **False** statement is selected.
IF > 5% Capacity Increase	If the improvement in capacity during the last two discharge cycles is more than 5% (for example, the last one is 90% and the one before is 80%), go to the **True** statement. Otherwise (for example, 88% and 85%, or 80% and 90%) the **False** statement is selected.

(Test continued)

Option	Description
IF Total Capacity < 5%	If the capacity during the last discharge cycle is less than 5%, go to the **True** statement. Otherwise the **False** statement is selected.
IF Total Capacity > 5%	If the capacity during the last discharge cycle is greater than 5%, go to the **True** statement. Otherwise the **False** statement is selected.
IF User Defined Timeout	If the time period set in **Cycle 1** or **Cycle 2** has expired before the battery is fully charged, discharged or reconditioned, go to the **True** statement. Otherwise the **False** statement is selected. For Trickle Charge and Rest, the program will proceed to the **True** statement only.
IF Loop Count < Max	If the number of cycle (the loop count) is less than the value set in 'THEN REPEAT *0* times' of the **True** statement or 'ELSE REPEAT *0* times' in the **False** statement, go to the **True** statement. Otherwise the **False** statement is selected.
IF Loop Count > Max	If the number of cycle (the loop count) is more than the value set in 'THEN REPEAT *0* times' of the **True** statement or 'ELSE REPEAT *0* times' in the **False** statement, go to the **True** statement. Otherwise the **False** statement is selected.

BATTERY SERVICE REPORT

Company: CADEX ELECTRONICS
Date: 01/19/2000
Time: 16:47:11

BATTERY STATUS

Battery: STATION 2
Battery ID: 1234567890

Current Cycle: PROCESS COMPLETE
Cycle Capacities: 30% 82% 98%
Battery Resistance: 122mΩ
Cell Voltage: 3.91V/cell
Charge Cycles: 3
Discharge Cycles: 3
Recondition Cycles: 0
Elapsed Time: 0 Days 6 Hours 40 Minutes

BATTERY PARAMETERS

Battery C-Code: 40-02-016:0505-505-3407
Program: Auto
Target Capacity: 80%

Battery Type: 42 - Lithium Ion
Number of Cells: 2 (7.2V)
Battery Rating: 400mAh

Charge Rate:	0.50C (200mA)	Max. Charge Voltage:	4.10V/Cell
Discharge Rate:	0.50C (200mA)	End Discharge:	4.10V/Cell
End of Charge:	0.10C (40mA)	Max. Standby Voltage:	4.05V/Cell
Capacity Offset:	0%	Temperature Sensing:	5ºC - 45ºC

FAULT CODES

FINAL STATUS

Ready

Battery Service Report

Please visit the Cadex Web site for a print sample of the System Setup Report.

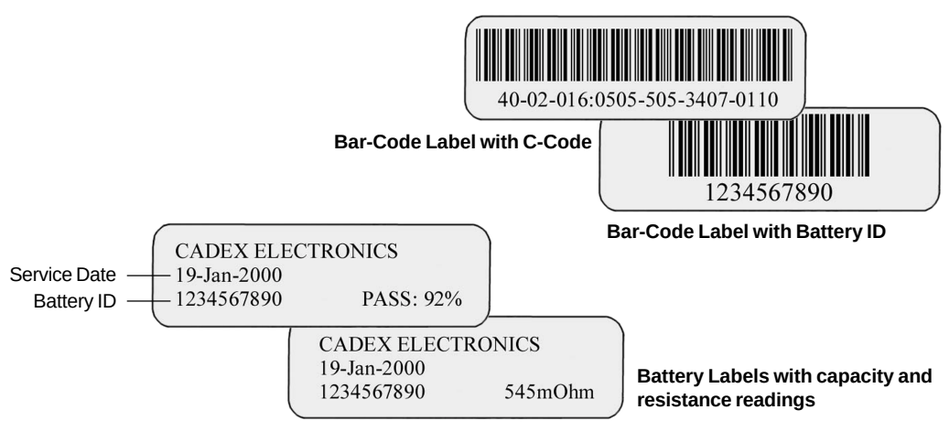
Printing Report or Label

- Select the report or label on the menu.
  - For Battery Service Report and Battery Label, press the station key of the corresponding station, then select **Yes** to start printing.
  - For Bar-Code Label, specify the label type and press the station key of the corresponding station. Then select **Yes** to start printing.
  - For auto print, select the option, then **Yes** to confirm.

Print Utilities

Battery Service Reports and Battery Labels must be printed *before* removing the battery *with the exception of Auto-Print*. Once the battery is removed, the station resets to prepare for the next battery, and the battery information is lost.

Report/Label	Description
Battery Service Report	Lists Battery ID, type, number of cells, rating, and cell voltage. Also describes the C-Code, cycles performed, Charge/Discharge rates, any applicable fault codes and final capacities.
Battery Label	Contains company name, date, test result with any fault codes, and the Battery ID number (if available). To be attached to the batteries after service.
Bar-Code Label	Contains Battery ID or C-code.
System Setup Report	Lists time, date, company name, serial port and printer port settings, event logging setup, adapter setup and Custom Program information.
Auto-Print	The system automatically prints a Battery Service Report or Battery Label when a battery is removed from the analyzer after service. Default setting is **Neither**.



Battery Labels with capacity and resistance readings

True and False Statements

Option	Description
THEN Goto Next Phase	Go to the next phase.
THEN Goto Phase 1	Go to **Phase 1**.
THEN Goto Phase 2	Go to **Phase 2**.
THEN Goto Phase 3	Go to **Phase 3**.
THEN Goto Phase 4	Go to **Phase 4**.
THEN Goto Phase 5	Go to **Phase 5**.
THEN Goto Done	Go to **Phase Done**.
THEN REPEAT *0* times	Repeat actions in the current phase by the number of times specified. Available settings: 1-8 and **Forever**. If **Forever** is selected, the cycle repeats for 255 times. Refer to 'IF Loop Count < Max' and the 'IF Loop Count > Max' in ***Test***.
THEN REST for *000:00:00*	Apply no current for the specified time period (in hhh:mm:ss format). The Resting xx:xx message (code 19) is displayed. After resting, the program goes to the next phase.
THEN FAIL	Fail the battery. The battery is electrically disconnected and the Fail 16 code will be displayed with the FAIL light on.

Phase Done

Option	Description
Ready - No Charge	Complete the program. The READY light will be on and no trickle charge is applied.
Ready - Trickle Charge	Trickle charge the battery according to the Trickle Charge rate in the Extended C-Code. Includes the Standby maintenance cycle which periodically performs discharge/charge every 30 days (180 days for SLA).
Trickle Charge	Trickle charge the battery according to the Trickle Charge rate in the Extended C-Code.

Example

NiCd or NiMH batteries that do not meet the Target Capacity should always be reconditioned. If the battery does not meet the Target Capacity after reconditioning, the program will fail the battery. This is a shortened version of the **Auto** program because this program does not determine the initial capacity of the battery when it came from the field.

Phase	Action
Phase 1	Discharge for *10 minutes* to avoid charging a fully charged battery. Then fully charge the battery.
Phase 2	Discharge to find the battery capacity. If the capacity meets the Target Capacity, complete the program (Phase Done). If the Target Capacity is not met, apply the recondition cycle (Phase 3).
Phase 3	Recondition and charge the battery.
Phase 4	Discharge to find capacity after the recondition cycle. If the capacity meets the Target Capacity, charge the battery (Phase 5). If the Target Capacity is not met, fail the battery.
Phase 5	Fully charge the battery.
Phase Done	Complete the program with a trickle charge to maintain capacity.

DB-9 to DB-9

DB-9				DB-9
RD	2	--	3	TD
TD	3	--	2	RD
CTS	8	--	7	RTS
RTS	7	--	8	CTS
SG	5	--	5	SG

Note: If connecting to a serial printer, it may also be necessary to jumper pins 6 (DSR), 1 (DCD), and 4 (DTR) together on the printer's DB-9 connector. Other jumpers may be also required. Check your printer manual for specific information.

Serial and Parallel Port Device Settings

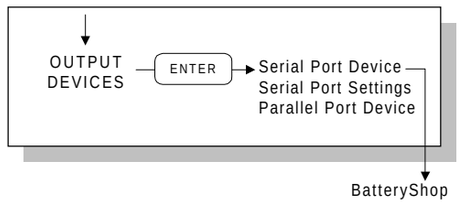
The serial port is a DB9 connector which is standard on all models and is located at the back of the analyzer.

Option	Description
Disabled	No output is provided to the serial port.
Printer	Print reports and labels on a *serial* printer.
LabelMaker	(Default Setting) Print Bar-Code Labels and Battery Labels on a DYMO LabelWriter SE300 Printer.
Computer	Transfer service data to the computer.
BatteryShop	Connect to BatteryShop.

The parallel port is a DB25 connector available only to analyzers with the OP-70 or OP-72 option board.

Option	Description
Disabled	No output is provided to the parallel port.
Printer	(Default Setting) Print reports and labels on a *parallel* printer.
LabelMaker	Print Bar-Code Labels and Battery Labels on a DYMO LabelWriter SE300 Printer.

Output Devices



Serial Port Settings

Before connecting any device to the serial port, match the serial port settings with those of the device being connected. *Consult the device's manual for the proper settings.*

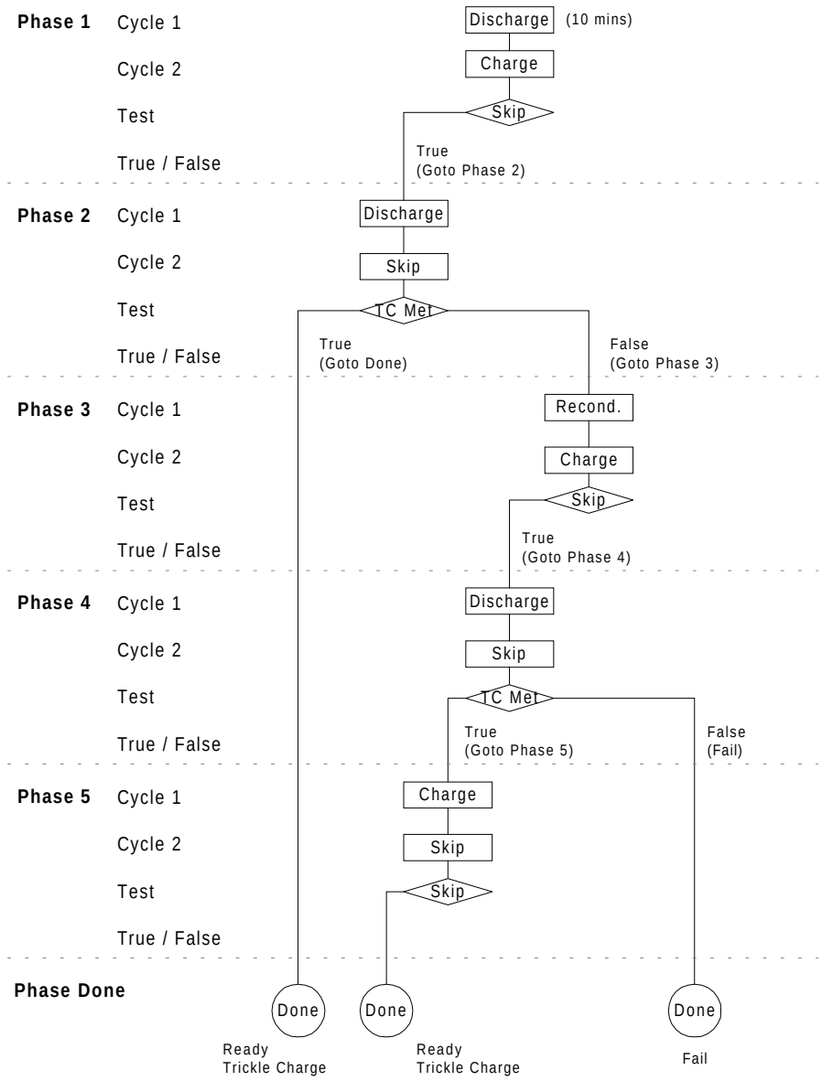
Option	Available Settings	Default
Baud Rate	1200, 2400, 4800, 9600	9600
Handshake	NONE, CTS/RTS, XON/XOFF	CTS/RTS
Data Bits	7, 8	8
Stop Bits	1, 2	1
Parity	NONE, ODD, EVEN	NONE

Serial Cable Pin Configurations

DB-9 to DB-25				
DB-9			DB-25	
RD	2	--	2	TD
TD	3	--	3	RD
CTS	8	--	4	RTS
RTS	7	--	5	CTS
SG	5	--	7	SG

Note: If connecting to a serial printer, it may also be necessary to jumper pins 6 (DSR), 8 (DCD), and 20 (DTR) together on the printer's DB-25 connector. Other jumpers may also be required. Check your printer manual for specific information.

The following flowchart demonstrates the routines of the program:



Creating or Modifying a Custom Program

1. Select **Program Settings** on the menu. Refer to ***Menu***.
2. Select the program. For example, **Custom 1**.
3. Press **Prog**. If applicable, enter the program name, then press **ENTER**. You can enter up to 9 characters/numbers. Otherwise press **Esc** to skip.
4. Enter the program settings.
   - Use the ↑ and ↓ keys to scroll through the phases and cycles or select the settings. Move between the fields using the → and ← keys.
5. Press **ENTER** when all the settings are entered, then select **Yes** to accept changes.

1. Make sure that no Battery Adapter is inserted.
2. Select **Voltage Calibration** on the menu.
3. Firmly insert the 4 Voltage Calibration Adapters into each station.
4. Wait for the prompt, then remove the calibration adapters.
5. Press **Menu** to return to the Global Display.
6. Press **Fn**-**7**. The “#” sign should appear in the upper right corner of the startup screen, indicating successful completion of voltage calibration.

Calibrating Station

Failing to calibrate Battery Adapters could cause inaccurate capacity readings, especially on low voltage batteries or single cells. *Recalibrate adapters when they are moved from one station to another.*

1. Make sure that there is no battery inserted into the adapter.
2. Select **Station Calibration** on the menu. You can also press **Fn**-**8**.
3. For each station, select the station and short the battery leads *on the adapter* together using a short length of heavy gauge wire (AWG 10).

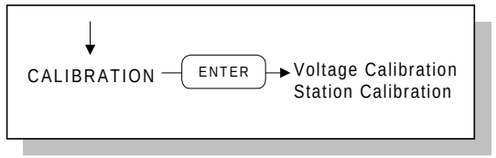
Warning: Never short the contacts on the battery.

4. Once the display indicates that a good connection has been established, press **ENTER** to start calibrating.
5. Wait for a few seconds and remove the wire when prompted.

Setting Up System Information

1. Select the feature on the menu.
2. Enter the required information or select the settings.
   - Use the ↑ and ↓ keys to scroll through and select the option, numbers or characters in both upper and lower cases.
   - Use the → and ← keys to move the insertion point.
3. Select **Yes** to accept changes.

Calibration Procedures



Calibrating Voltage

You need a calibration kit (P/N 92-770-0210). This kit can be purchased from Cadex or through your Cadex Representative. The C7000 calibration kit consists of 4 calibration adapters (P/N 07-130-0000) and an instruction sheet (P/N 89-204-1017).

Servicing the Voltage Calibration Adapters: Return the Voltage Calibration Adapters to the factory every 3 years for authorized calibration. Call Cadex for a Return Authorization number.

System Security

The C7000 and C7000ER offer three security levels for protection against tampering: Level 0 (Off) is the default, Level 1 (Low) and Level 2 (High). Depending on the security level, you will be asked to enter the password for some features.

A password must have at least 3 digits. You can control the access to the features by setting the security level.

Password Requirement

	Level 0 (Off)	Level 1 (Low)	Level 2 (High)
C-Code	Not required	Edit C-Code	Edit C-Code Set Default C-Code
Security	Not required	Set Security Change Password Remove Security	Set Security Change Password Remove Security
System Setup	Not required	Time/Date Program Settings Output Devices	Time/Date Battery Startup Program Settings Company Name Calibration Output Devices Sound Control Voltage Display
Print Utilities	Not required	Auto-Print	Battery Service Report Battery Label Bar-Code Label System Setup Report Auto-Print
Event Log	Not required	Clear Event Log Events to Log	Clear Event Log Events to Log

Setting Security

1. Select **Set Security** on the menu.
2. Enter the desired security level (0, 1, or 2) or select the security level using the ↑ and ↓ keys. Then select **Yes** to accept changes.

Changing Password and Removing Security

- Select **Change Password** or **Remove Security** on the menu.
  - To change the password (for Level 1 and Level 2), enter the old password. Then enter and re-enter the new password.
  - To remove security, select **Yes**. Then enter the password.

Feature	Description
Time/Date	Set up the time and date information printed on Battery Labels, Battery Service Reports and Event Log. Analyzers with an option board have battery backup RAM that retains dates and times on power interruption or when the analyzer is turned off. Default: current date and time.
Battery Startup	Specify if the analyzer will ask for the Battery ID and/or C-Code when a battery is inserted. Specifying the Battery ID and C-Code prevents the use of wrong settings. Default: **No** for Battery ID and **Yes** for Battery C-Code.
Program Settings	Edit program settings. Refer to ***Editing Program Settings***.
Company Name	Set up the company name for printing on Battery Labels and Battery Service Reports. You can enter up 20 characters/numbers. Default: CADEX ELECTRONICS.
Calibration (Shortcut: **Fn**-**8**)	Correct variations of component tolerances due to aging. Calibrating the voltage once a year maintains performance specifications, especially for Li-Ion batteries. Station Calibration compensates for voltage loss from cables and electrical contacts.
Output Device	Connect the analyzer to a printer, label printer or BatteryShop.
Sound Control	Turn on or off the audible signals for Key Press events and Alert events. Default: **Yes** for both Key Press events and Alert events.
Voltage Display	Set voltage display mode to **Volts/Cell** or **Volts**. Default: **Volts/Cell**.